agricultural research

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The Information Game

SEA is in the new technology business. A continuously expanding population, a growing foreign reliance on American agriculture, and the increasingly stringent financial parameters within which farmers and ranchers must operate, all combine to make the creation of new knowledge one of our most pressing demands. We need to get that new knowledge into the hands of the people who need it. And we need to do it efficiently.

Ways in which SEA researchers and communicators spread the word about their findings vary almost as widely as the research itself. SEA information people, working with scientists, produce reports, brochures, articles, and feature stories. But there is also a need for a more personal communication.

In Peoria, for example, at the Northern Regional Research Center, about 1,000 representatives of private corporations, associations, and foreign governments visit each year to learn about new developments in soybeans, cereal grains and other crops, including unusual and exotic plants for which uses have not yet been identified. At laboratories throughout the country, SEA researchers host ongoing briefings, open houses, and demonstrations. They explain displays, describe research, interpret results, answer questions—continuously passing on their new technology. These face-to-face meetings occur every day throughout the country—in high-rise office buildings, in chemistry labs, on sun-drenched deserts amid rows of jojoba and guayule plants.

Essentially, the purpose is to keep pace with America's constantly expanding need for food and fiber. But to serve those needs means to anticipate them. And nowhere amid this spectrum of communications activity are SEA's efforts more directly attuned to America's need for inexpensive, nutritious animal protein than is the work of a Regional Research Project called "Freshwater Food Animals," partially funded by SEA. Through this project, scientists exchange unpublished research information, plan future research, and avoid duplicating their work.

SEA research in the field of aquaculture includes breeding varieties of fresh water fish for more efficient growth; research to determine requirements for oxygen and feed, for water temperature and quality; and research in stocking rates, harvesting methodology, and other practices—all aimed at producing the most fish of the highest quality using the least amount of water, space, feed, and human labor.

Throughout agricultural research, and especially in aquaculture where intensive research in the United States is relatively recent, the work of those who deliver information to other scientists, and to the farmers using that new technology is, for SEA, a public trust and an essential responsibility.—Robert W. Deimel

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COVER: In high contrast, this potato herbarium specimen becomes art. These dried and pressed plants are one of many research tools used by scientists at the Inter-Regional Potato Introduction Project (IR-1) at Sturgeon Bay, Wis. (PN-4185) (story begins p. 8).

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Bob S. Bergland, Secretary
U.S. Department of Agriculture

Anson R. Bertrand, Director of
Science and Education

Above: *Contrast is obvious between a plant showing adequate nitrogen fixation and one with a deficiency (0379X236–15).*
Right: *Examining soybean plants grown in nitrogen-free medium, plant physiologist Barbara Breithaupt and Devine make visual "Scores" of plant leaves (0279X155–29).*

Nitrogen Fixation in Soybeans

IMPROVING the symbiotic nitrogen-fixation relationship between legumes and *Rhizobium* bacteria to develop higher yielding soybean cultivars is the aim of researchers at the Cell Culture and Nitrogen Fixation Lab at Beltsville, Md. SEA plant geneticist Thomas E. Devine has proposed a system to provide growers with a "package" consisting of soybean cultivars that reject infection from all but select strains of *Rhizobium*, and an inoculum of the select, highly-efficient *Rhizobium*.

Devine points out that there are

Right: After uprooting a healthy soybean plant, Breithaupt evaluates nodule growth (0379X237–3A).

For further nodulation testing, Breithaupt and laboratory aide Joanne Morris inoculate soybean seeds with Rhizobium strains. (0379X238–4).

several known strains of *Rhizobium* that are better at fixing nitrogen than the native, or indigenous strains generally present in most soybean fields. Also, he says that it is widely believed that more efficient nitrogen fixation in soybeans would lead to increased yields. However, at present there is no economically feasible method of establishing the more desirable strains in the field against the competition of the less efficient indigenous strains.

Devine's unique system involves three parts. One part requires a soybean cultivar that resists or rejects infection by indigenous *Rhizobium* found in most soybean fields. This is being accomplished by breeding the rare rj_1 gene into soybean cultivars. This mutant gene, discovered by federal and state researchers in 1954, prevents nodulation by the indigenous *Rhizobium.*

In his research on the second part of the system, Devine is seeking superior strains of *Rhizobium* that can overcome the rj_1 resistance in soybeans. These desirable strains would then be able to nodulate the rj_1 soybean plants which reject the less efficient indigenous strains. In his 1977 experiments, 30,000 soybeans were planted in the field, then carefully screened for nodulation. Only 34 nodules were found.

In the 182,000 soybeans planted in 1978, 123 nodules were discovered. An individual inoculum was prepared from each of the 157 nodules recovered, and currently each of them is being tested in the greenhouse for ability to overcome *Rhizobium* rejection in rj_1 soybeans.

The third part of the system is expected to come from studies being conducted by SEA microbiologist L. David Kuykendall. He's working on procedures for the genetic exchange in *Rhizobium japonicum* which is necessary for breeding *Rhizobium* for improved nitrogen-fixation ability. This would permit the combining, in the same *Rhizobium* strain, of highly competent nitrogen-fixation efficiency with improved nodulation.

"It appears that we're on the right track," says Devine. "We're getting some rj_1 infections. The premise seems to be proving out and I'm optimistic that we'll also find the aggressive *Rhizobium* strains we're looking for—those that can infect rj_1 plants and that are highly efficient at nitrogen-fixation as well."

The address of the Cell Culture and Nitrogen Fixation Lab is Rm. 218, Bld. 001, BARC-West, Beltsville, MD 20705.—*L.W.S.*

New Horizons in Gas Chromatography

Need a quick and easy method to monitor the flavor of peanut butter? Or vegetable oils? Or other food products? Or assess the flavor potential of a new peanut variety or other agricultural commodity?

New techniques in gas chromatography developed by SEA chemist Harold P. Dupuy and a research team at the Southern Regional Research Center promise to meet all these requirements and many more.

While conducting research on vegetable oils, Dupuy was searching for a way to determine flavor changes in the oils without having to resort to human taste panels. Such taste panels are subjective at best and, unless the members are very well trained and carefully selected, they vary considerably in their responses. Dupuy was looking for a completely objective method to evaluate flavor and to help processors extend the product shelf life. He found the answer in the gas chromatograph.

Dupuy and a team of chemists and chemical engineers discovered that the volatile content of the oils correlated remarkably well with flavor scores of trained taste panels. The researchers soon determined that by working with taste panels, a chromatographic profile could be developed for each product which could then be monitored quickly and inexpensively.

Although the importance of the new technique to the food processing industry is readily apparent, the technique can also be of vast importance to plant breeders. According to Dupuy, it could save up to 10 years of developmental research and as much as $250,000 in developing a single new peanut variety.

Developing and testing a new peanut variety currently requires 10 to 15 years. In the screening process, many new varieties must be grown to produce sufficient quantities of peanuts for taste tests. When the objective gas chromatographic technique is fully developed, it should be possible to do most or all of the screening with peanuts grown in a single season. With only the few peanuts available, the gas chromatographic procedure can determine within 2 hours whether a given plant selection should be increased or discarded.

In a typical test, less than a gram of ground raw peanuts is placed in the chromatograph. By comparing the chromatograph reading of the product under test with a known standard, the quality, commercial potential, and shelf life can be quickly determined.

Dr. Harold P. Dupuy is at the Southern Regional Research Center, P.O. Box 19687, New Orleans, LA 70179.—*V.R.B.*

A NOSE IN THE COMPUTER LOOP

While the team of scientists at New Orleans have been employing sophisticated analyzers to monitor flavors of vegetable oils, chemists at the Northern Regional Research Center, Peoria, Ill. have coupled a human touch to instruments for analyzing the odors of food oils.

Herbert J. Dutton and others at the Northern Center have developed a technique that adds a nose to the analytical instrumentation to record its owner's reactions to volatile materials from food oils. Odor is, of course, fundamental to flavor.

The flow of volatile materials from the chromatographic column is split into three streams. One goes to a flame ionization detector, which counts the components and records the amount of each. Another stream goes to a mass spectrometer, which with an on-line computer identifies each component.

The third stream goes to the nose. The owner records the intensity of the odor at the same time the instruments are recording the analyses. Dutton calls this "the nose in the computer loop."

Relating human reactions to identified odors provides information that can be used in research to inhibit the development of undesirable odors in vegetable oils, Dutton points out.

The address of the Northern Regional Research Center is 1815 N. University St., Peoria, IL 61604.—*D.H.M.*

Whiteflies Stick to Yellow Boards

WHITEFLIES, a major insect pest of greenhouse crops and often a problem for home gardeners, can be controlled with sticky yellow boards, say SEA scientists at Beltsville, Md. In experiments, entomologists Ralph E. Webb and Floyd F. Smith showed that home owners and small-scale growers of greenhouse crops could use the boards to keep whiteflies away from a variety of plants.

Actually not a fly, but related instead to aphids, mealy bugs, and scale insects, the tiny greenhouse whitefly, *Trialeurodes vaporariorum*, is one of the most difficult of agricultural pests to control. It attacks most greenhouse crops.

According to Webb and Smith, the only effective insecticides against whiteflies are pyrethroids—high-priced synthetic substitutes for a natural insecticide extracted from pyrethrum plants. However, since 1970, Webb and Smith have kept the troublesome whiteflies away from experiments on other types of insects by taking advantage of the whitefly's natural attraction to the color yellow. Near plants used in their research, the insect biologists arrange small plywood boards, painted yellow and covered with a sticky, transparent substance.

The boards have consistently trapped and held whiteflies so well that the scientists designed special experiments to test the idea. Each experiment was

Left: *After applying a sticky substance, entomologist Floyd Smith arranges the yellow boards between each tomato plant. (0179X60–37).*
Below: *Shown here on a poinsettia leaf, the adult whitefly grows to a length of 1 millimeter, and is attracted to many greenhouse plants (0179X63–5).*

conducted in a separate 12- by 12-foot greenhouse.

In one experiment, Webb and Smith placed 1-foot square boards between tomato plants infested with whiteflies. Each day thereafter, the boards trapped 25 percent of the adult whiteflies until the infestation was under control.

In a second experiment—on infested chrysanthemum plants—12 boards evenly dispersed among the plants eliminated adult whiteflies in 48 hours.

In a third experiment, the scientists demonstrated the use of sticky, yellow boards with another nonchemical control method—a parasitic wasp called *Encarsia formosa,* which is a natural enemy of the whitefly. The combined methods provided virtually complete control of whiteflies in the greenhouse. While the parasites attacked and killed immature whiteflies, the boards trapped adults. (*E. formosa* is sold as a control agent for whiteflies in Canada, England, Holland, and Norway, but is not yet commercially available in the United States.)

Smith attributes the success of the yellow boards to the restless nature of whiteflies. As they fly from leaf to leaf, they are distracted by yellow and become stuck on the surface of the boards. The insects are attracted from several feet and, when infested plants are shaken, most adult whiteflies dart to the boards "like iron fillings to a magnet," say the scientists. The best use of the boards, they say, is for keeping uninfested plants from getting whiteflies, rather than for controlling "roaring populations."

The yellow boards in the SEA experiments were painted with Rust-Oleum 659 Yellow, but other deep orange-yellow paints also would be effective. Of the many sticky substances tested, Webb found that Tack Trap, a commercial insect trapping compound, is the best. (These products are mentioned only as part of the research, and are not recommended by USDA over other products.) Smith found that heavy motor oil (SAE 90) is also an effective trapping material and that it is easier to wash off the boards than Tack Trap. The oil was used in most of the experiments reported here.

Smith, working with SEA agricultural engineer Richard Dudley, designed wire cages for the yellow sticky boards. The cages prevent people and plants from contacting the sticky material, but do not interfere with the effectiveness of the yellow boards.

Dr. Ralph E. Webb and Dr. Floyd F. Smith are located at Building 470 (East), Beltsville Agricultural Research Center, Beltsville, Md. 20705.—*S.M.B.*

Gasohol from Sugarcane

With the increased interest in sugarcane as a possible source of biomass for the production of alcohol for fuel, SEA plant breeders are giving more emphasis to the development of varieties suited for biomass. Such a variety would produce heavy tonnage, high fiber, and high Brix (percentage of total solids in the juice), but could be lower in sucrose than varieties for sugar production.

A recent study showed that much higher cane tonnages could be produced by early generation hybrids of a wild sugarcane species *Saccharum spontaneum,* than present commercial sugar varieties produced in Louisiana. Seasonal cane regrowth and tolerance to cold might make it possible to grow these early generation hybrids at higher latitudes, and on much larger acreages than sugarcane for sugar production.

Because of its high yield and production of total solids per acre, sugarcane is more likely to be used for gasohol than other agricultural crops. Success of the program will depend on a competitive fuel price, which might be achieved by higher sugarcane yields and increased oil prices. Improved varieties for biomass production are an inexpensive route to higher yield, according to Dr. Richard D. Breaux and Dr. Benjamin L. Legendre of the U.S. Sugarcane Field Laboratory, Box 470, Houma, LA 70361.—*E.L.*

Right: *Geneticists Hanneman (left) and Ross study herbarium specimens of various potato introductions. Herbarium specimens are the dried and pressed part of the plant; most commonly the part growing above the ground. (0578X579–27A).*
Below: *Pollen collected from anthers of potato introduction, Solanum immite, is used to fertilize introductions of the same genus and species to produce seed for distribution to potato breeders and scientists (0578X573–31).*

Potato— Rex Am

AT the IR–1 Potato Introduction Station at Sturgeon Bay, Wis., scientists are paving the way for a better potato.

Through a cooperative USDA-University of Wisconsin research project begun in 1956 with the Wisconsin Agricultural Experiment Station, researchers are studying the genetics, cytogenetics, and physiology of the tuberbearing *Solanum* species of potatoes.

The present project leader is SEA research geneticist Robert E. Hanneman Jr., Roman W. Ross is project assistant from the University of Wisconsin.

The *Solanum* species is a reservoir of significant genetic diversity—a treasure chest just waiting for the right key that will unlock its secrets. Introductions are evaluated for desirable economic characters and breeding behavior. Scientists then incorporate the positive attributes into new commercial varieties. This evaluation requires the cooperative efforts of private, state, federal, and foreign laboratories.

Foreign potato introductions play a major role in modern U.S. potato breeding. Thirty-four distinct foreign intro-

Left: *Fruit is collected from potato introductions by Wisconsin state agricultural technician Margaret DeVault. Seed within the fruit will be extracted, dried, and packaged prior to storage and distribution (0578X574–28).*
Above: *Wisconsin state agricultural technician Jean Smejkal counts and packages seeds to honor requests for germplasm from scientists and potato breeders around the world (0578X576–21A).*
Below: *Hanneman displays wild potato species with distinctly different physical characteristics. The introduction on his left is from Mexico, the other from Bolivia (0578X575–13A).*

ng Plants

ductions from 9 European, 5 South American, and 2 Central American countries have contributed to parentage of 142 of the 146 potato varieties released since 1932. They contributed genes for resistance to late blight; scab; viruses A, X, Y, and leaf roll; bacterial ring rot; golden nematode and frost. These 142 varieties comprise more than 65 percent of the U.S. annual seed potato production.

The potato yields 1½ times as much food value per acre as cereal grain crops and provides twice as many calories and more protein per acre than cereal grain

Right: *Tubers from the same introduction "family." These tiny wild potatoes demonstrate the genetic diversity obtainable in a single accession. To potato geneticists and breeders, this variability means a larger gene pool to work with (0578X581–35A).*
Above: *The Inter-Regional Potato Introduction Project is located at the 120-acre University of Wisconsin Peninsular Branch Experiment Station, Sturgeon Bay, Wis. (0578X570–26).*

crops. Potato protein is nutritionally as good as or better than soybean protein and far exceeds the nutritive value of grains and legumes. Four ounces of raw potato supplies 100 percent of the minimum daily requirement for vitamin C.

Potatoes are cultivated on more than 50 million acres throughout the world and yield more than 300 million tons of tubers yearly. The potato has two centers of origin: Mexico, and an area that includes parts of Peru, Bolivia, and Argentina. Well before 200 A.D. this crop became the staff of life for highland people.

The United States annually produces about 15 million tons of potatoes on 1.5 million acres with a crop value of over 1 billion dollars. From its humble origin, this "Rex" among plants has made its way to the forefront in the world market as a major food crop.

Foreseeing this growing importance in the marketplace, the Potato Association of America in 1947 documented the need for a germplasm center where wild and cultivated *Solanum* species could be introduced, preserved, classified, distributed, and evaluated. Potato breeders in the North Central Region prepared a formal project outline, which served as a format for the regional program begun in 1948. Wisconsin was chosen as the site of the germplasm center, with its main operation at Sturgeon Bay and associated research at Madison.

Since 1950, the project has been a cooperative interregional (IR–1) program supported by the states of all four regions and the federal government. Project objectives remain to:

- introduce, preserve, and classify the wild and cultivated tuberbearing *Solanum* species, and
- distribute introductions to potato breeders and other scientists.

Even though the USDA research activities are budgeted independently of IR–1, the project mainly explores uses of the IR–1 plant materials. The research bridges the gap between the work program of IR–1 and the work programs of potato breeders in various government agencies and in industry.

Species interactions provide clues to genecytoplasm interactions and incompatibility. Researchers use the frost-resistant species to explore the plant's basic reactions to cold temperatures and

to build frost resistance into breeding programs.

A chromosome identification scheme was first worked out using Group Andigena haploids. Using a selection from Group Phureja as a pollinator, a method was devised to routinely isolate haploids from common varieties. Species Group Tuberosum haploid hybrids were used to study unreduced gamete formation, the meiotic mutants underlying them, and their breeding potential.

The cultivated potatoes, Groups Phureja, Stenotomum, and Andigena, are being adapted to temperate latitudes for breeding and the exploitation of their germplasm and heterosis. With trisomics coming from *S. chacoense* background, scientists can now relate genes to specific chromosomes.

All U.S. potato varieties are of 48 chromosomes, although almost 70 percent of "wild" potato introductions have 24 chromosomes. Geneticists now suspect that all original potato germplasm had 24 chromosomes. Hanneman says 24-chromosome hybrids provide greater vegetative vigor, greater yield, and the ability to breed-in better disease and pest resistance.

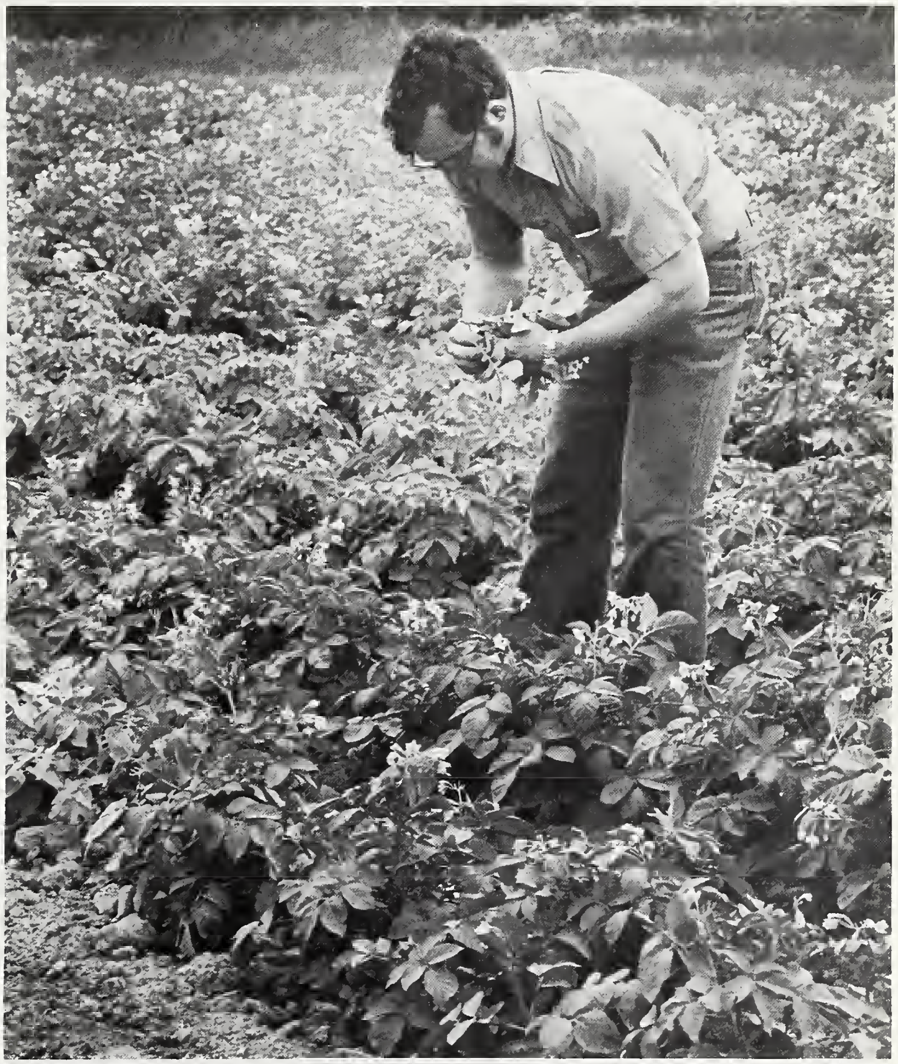
Chromosomes are responsible for the determination of and transmission of hereditary characteristics.

All introduced clonal materials entering the United States are received by the USDA Plant Germplasm Quarantine Center, Beltsville, Md. Stocks are processed initially by the USDA Germplasm Resources Laboratory, Beltsville, Md., and are assigned a Plant Introduction (PI) number. Materials are then sent to the USDA Plant Introduction Station, Glenn Dale, Md., where they undergo 1 to 2 years of intensive quarantine screening before being released to the Potato Introduction Project at Sturgeon Bay, for maintenance and distribution. All true seed accessions can come directly to IR–1 without going through plant quarantine.

Project scientists first build up stocks of introduced species. To avoid the spread of virus diseases, the stocks are reproduced in greenhouses during the winter and in screenhouses during the summer. Almost 90 percent of the species introductions are presently maintained as true seed. Most introductions are maintained by a system of sib-mating but when sibbing is not possible, self and hybrid seed are obtained. Twenty clones of each introduction are grown. When at least 15 clones flower, bulk pollen is collected and used to pollinate all clones flowering at that time. This process is repeated until all plants have served as parents.

The seed remains viable for about 15 years. New increase cycles are begun when most seed of a lot has been distributed or when the germination falls below 50 percent.

Dr. Robert E. Hanneman, Jr., is located at the Department of Horticulture, University of Wisconsin, Madison, WS 53706. Roman W. Ross is located at the Potato Introduction Station, Sturgeon Bay, WS 54235.—*P.L.*



Hanneman takes cutting from common 48 chromosome U.S. potato varieties grown to cross breed with a species clone for haploid extraction. (0878X974–11).

Beans Snap Up European Market

A SEA researcher has developed a new type of seed harvester that could make the U.S. snap bean seed more attractive to the European market and more than double current demand.

The new self-propelled harvester operates on much the same principle as hand harvesting where seed is shelled by the rapid rubbing together of a person's palms. With the new machine, bean seed is extracted from pods by passing the pods between two parallel rubber belts, one which travels much faster than the other.

Matt J. Silbernagel, SEA plant pathologist, Prosser, Wash., designed the rubber belt machine to harvest seed for his own snap bean breeding program.

To enhance the use of snap bean varieties in the home garden or commercial production, or in canning and freezing operations, breeders have removed the string and much of the pod wall fiber. Although the snap beans taste better, they are more difficult to extract and much more susceptible to mechanical damage when harvested for seed.

Conventional mechanical harvesters were designed for cereal grains and rely upon the violent impact of steel rods or rub bars on the pods to separate seed from other plant parts. This procedure is fine for cereal grains, but much too rough on snap bean seed. Even threshers modified with rubber-coated rub bars damage too many seeds.

Damaged seed that is subsequently planted and does germinate is more vulnerable to diseases and adverse emergence conditions such as cold, wet weather. Studies indicate that beans could be yielding 15 to 20 tons per acre using close row spacing in high population density with high quality seed instead of the 4 to 5 tons per acre currently being averaged in 36-inch rows. Use of the rubber belt harvester with its greatly reduced seed damage could help growers achieve that potential.

Perhaps the rubber belt harvester's most important impact will be on the foreign market. Europeans consume a lot of fresh and processed snap beans but because of the continent's wet environment (which favors seed-borne diseases), they have been producing seed in Africa for many years. Europeans have favored hand-harvested African seed over American seed because of the differences in germination rates and lower cost.

Shifting political situations and technological problems have made production in Africa an increasingly unstable situation. With the development of the rubber belt harvester, Europeans can now look favorably on the United States supplying seed beans.

The current U.S. domestic market for snap bean seed is approximately $50 to $60 million. The European market for seed could easily equal that projection figure. In addition to snap beans, the rubber belt harvester can also be used on flowers and vegetables. Silbernagel believes the harvester might also work equally well with soybeans.

Dr. Silbernagel is located at the Irrigated Agriculture Research and Extension Center, P.O. Box 30, Prosser, WA 99350.—*L.C.Y.*

Defining Fitness

JOGGERS take note!

Try maximal treadmill stress testing. It could fatigue you—and show your fitness. Scientists are interested in learning whether the continuous and vigorous exercise also affects your body's dietary need for trace minerals such as magnesium, copper, and zinc.

The young man in these photographs may discontinue exercising at his own request—or in the judgment of the researchers. Blood pressure, heart beat, and other cardiovascular measurements are continuously recorded as the speed and steepness of the treadmill is steadily increased in the endurance test.

At SEA's Human Nutrition Laboratory, Grand Forks, N. Dak., the type of testing illustrated here has been confined to athletes of the University of North Dakota—in this case a tournament-class tennis player. But future tests could help researchers study measures of physical fitness and nutritional status among more sedentary people.

SEA medical officer Leslie M. Klevay and his colleagues of the university's medicial school suspect that extensive physical exertion may affect metabolism of trace minerals and the amounts of trace minerals that make up body tissue. Metabolism is all of the chemical changes that occur in body processes—movement, growth, tissue repair, and maintenance.

Dr. Klevay's address is P.O. Box 7166, University Station, Grand Forks, ND 58201—*G.B.H.*

(0578X553–29)

(0578X551–24)

Salty Waste Water—An Irrigation Source?

FARMERS, ranchers, and water agencies could benefit from a 4-year study—just begun near Bakersfield, Calif.—on the use of brackish (salty) water to grow cotton and sorghum.

SEA scientists will conduct the research in cooperation with several local and state agencies. Included are the Kern County Water Agency (KCWA), Lost Hills Water District, and River West Farms, Inc. Assisting in the funding is the State Department of Water Resources, State Water Resources Control Board, and the Bureau of Reclamation. Mike Rector, geologist with KCWA, is the funding coordinator of the project.

The primary objective of the study is to determine the yield of cotton, under controlled realistic field conditions, when irrigated with saline agricultural drainage waste water. Other objectives will be to evaluate the extent of salt buildup in the soil that could limit crop yield, and to determine if the soil can be returned to normal by irrigating with water of low salinity.

Just as important for the San Joaquin Valley, and particularly Kern County, is a means of concentrating salt in drainage water from irrigation projects in an environmentally sound, economically feasible, and politically acceptable way.

Kern County, the southernmost portion of the irrigated Valley, has a serious drainage problem, more so than the rest of the Valley.

Historically, farmers and ranchers pumped water from underground sources for irrigation. When those waters played out, reservoirs were built and water was imported from the mountains—last year 300,000 acre feet went to Kern County. Outlets like the Kern River were dammed and left no natural channels for drainage out of the county. At present there are only about 2,000 acres drained by tile lines.

Rhodes sifts salt-laden earth in a Kern County cotton field to demonstrate extreme salinity caused by irrigation in an area with poor drainage. Researchers say this and similar fields can be reclaimed through high-volume irrigation which causes soil cleansing downward leaching (1178X1476–35A).

All irrigation water contains some salt. Transpiration by plants, and evaporation, concentrates the salt in the unused water. That saline water percolates to the underground watertable. In Kern County, the watertable is perched above an impermeable clay hardpan about 40

feet below the surface in some spots. Over the years, the brackish water has risen and is within 5 feet of the surface in some locations and at the 10 feet level over a wide area.

Nearly 28,000 acres in the county are now in what officials call a drainage problem area. Projections are that by 1985 about 100,000 acres will be in trouble, and that by 2005 nearly 137,000 acres will be in the same fix unless something is done about it.

That "something" will probably be a drainage canal to take the waste waters out of the Valley. Meantime, ways of using drainage water on a succession of salt tolerant crops to concentrate the salt into a lesser volume of water may be a means of cutting the size of the canal. The latter is part of the reason for the Bakersfield brackish water study.

At Bakersfield, the researchers—led by James D. Rhoades and Stephen L. Rawlins—will irrigate the crops with three levels of salinity. Under study will be low salinity water from the state aqueduct (200 parts per million [ppm]), high salinity water from a brackish well near the site (5,800 ppm), and a mixture of the two (3,000 ppm). Sea water is about 35,000 ppm. Water is drinkable up to about 1,200 ppm.

Application rates for the water will be adjusted to the salinity level of the water being used. Higher salinity water will require an extra amount of water over and above what is needed by the plants and evaporation. The extra water is called the "leaching fraction." It leaches salts below the root zone to minimize salt damage to the plants. Low salinity waters will require smaller leaching fractions. Some of the plots will be leached at the beginning of the season while others will be leached with each irrigation treatment.

Sorghum has been planted on the 10-acre site this first year to avoid disease problems and because of a later start. In subsequent years, cotton will be planted and irrigated by furrows.

During the first cropping season, researchers will evaluate the effect of saline water applied to nonsaline soil for the short term as might occur during a drought when good quality water is unavailable.

In subsequent years, the effect of saline water on saline soil will be studied to evaluate the suitability of such waters for continued, long-term use.

And lastly, the researchers will evaluate the problems associated with restoring saline soils back to normal with the use of low salinity water.

Researchers expect the study to verify predictions based on past experiments and theoretical considerations that full yields of cotton can be obtained with water of a quality not generally used or recommended for irrigation.

All pertinent management information coming out of the project will be passed on to interested farmers, extension workers, and water agencies.

Rhoades and Rawlins are stationed at the U.S. Salinity Laboratory, Riverside, CA 92501.—*J.P.D.*

New Process Profits Tomato Peeling

A NEW tomato peeling process reduces the amount of edible tomato removed along with inedible peels to about 5 percent for the easier-to-peel varieties. Current loss is about 15 to 25 percent of the original tomato weight. Reducing loss of edible product will avoid waste and help keep consumer prices down.

The new process, developed by SEA mechanical engineer William G. Schultz, and coworkers Harry J. Neumann, John E. Schade, and James P. Morgan, involves dipping tomatoes in a fatty acid and water solution for up to 3 minutes at approximately 150° F (65° C). The fatty acid loosens peels so that they can be gently rubbed off by a flat-bed of rotating rubber discs in about 15 seconds. The discs were previously developed at SEA's Western Regional Research Center, Berkeley, Calif.

Current commercial methods for peeling tomatoes are effective for peel removal but, at the same time, tend to loosen some of the underlying tomato tissue itself. This tissue becomes part of the processing waste and is unfit for consumption. These methods involve dipping tomatoes into a lye solution (sodium hydroxide) or steam treating.

"This process will not revolutionize the whole industry because it can only be used for specific, easy-to-peel varieties and depends on fruit maturity. Where the process can be used, it will result not only in reduced waste but also in the elimination of lye—an item that adds to production costs. Reduced waste also means less effluent to dispose of—another cost-saving feature," says Schultz.

Part of the reduced loss in this process is due to the fatty-acid and the pectin enzymes acting on the underlying (subcutinized) layers of the peel. Low temperatures used do not loosen as much tomato under the peel as conventional methods.

Studies were done primarily with octanoic acid because it is safe, one of the most effective, has less odor than some others, and is available commercially at a reasonable price.

The address of the Western Regional Research Center is 1333 Broadway, Oakland, CA 94612.—*D.H.S.*

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AGRISEARCH NOTES

Tiny Worm Controls Weeds

A promising biological control for a serious weed pest has been found.

SEA zoologist Calvin C. Orr says that the use of a nematode, or roundworm, as a biological control is quite rare. However, working in cooperation with the Texas Agricultural Experiment Station, Orr found a tiny nematode severely galling the leaves of the spiny weed, silverleaf nightshade.

Orr then conducted field and greenhouse tests to determine how effective the nematode was as a control, and whether it was host specific to the one weed.

The scientist found that more than half of the silverleaf nightshade plants with infected leaves during 1 year did not return the second year. Three or four years of infection by the nematode reduced silverleaf nightshade stands by 90 percent. Furthermore, tests on 40 other plant species have shown that the nematode is host specific.

The nematode attacks all parts of the weed except the roots, and infected leaves fall off in a few weeks. "An infected leaf," says Orr, "may swell to become one-half inch thick with a hollow center containing hundreds of thousands of nematodes."

The nematode spends the winter in the soil and emerges during the next growing season to infect more plants. It is spread by the wind in blowing dust and dead plant parts.

"The virulence, host specificity, and persistence of the nematode show it to be a promising biological control," says Dr. Calvin C. Orr, who is located at the Texas A. & M. University Agricultural Research and Extension Center, Route 3, Lubbock, TX 79401.—*B.D.C.*

Dead or Alive?

The first rapid, efficient method for separating living wheat roots from dead roots in the laboratory has been developed by a SEA biological technician.

Dead wheat roots frequently maintain such perfectly preserved skeletons that it is impossible to visually distinguish dead from living roots. Since dead roots in a core soil sample may outnumber living roots by four times, researchers counting roots for density values often obtain erroneously inflated figures.

Kathy J. Ward, Pendleton, Oreg., has changed all of that. By staining roots with a congo red stain, she can quickly and accurately separate the live from the dead. Living wheat roots are white and succulent and stain a bright—almost garishly so—red. Dead root tissues stain a brackish brown or pink color. The distinction between the two is readily obvious.

Ward's technique is easily incorporated into any routine laboratory root washing and measuring operation. First, roots are washed in water to rid them of soil particles. Congo red stain is then poured over the clean roots, alcohol is added to further discolor the dead tissue and all of the roots are then placed in water and stored in a freezer.

After thawing, the roots can be counted by hand and the dead roots discarded. Roots of different crop species can be distinguished from each other by the variation in the shades of red the living roots stain to. The technique works with all monocots (grasses), but not with legumes.

Kathy J. Ward is located at the Columbia Plateau Conservation Research Center, P.O. Box 370, Pendleton, OR 97801.—*L.C.Y.*

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